LHAPDF as a Fermilab product

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Les Houches Accord Parton Density Functions

- interface conceived at the Les Houches 2001 workshop by the PDF working group

- enable usage of Parton Density Functions *with uncertainties* in a uniform manner

- When PDFs with uncertainties are considered, a "fit" to the data no longer is described by a single PDF.

- Instead, a fit is represented by a PDF set consisting of many individual PDF members.

- Calculating the observable for all the PDF members enables one to reconstruct the uncertainty on the observable.

LHAPDF

- written by Walter Giele

- http://pdf.fnal.gov/

- The LHAPDF interface was made with the Les Houches Accord in mind and manipulates PDF sets.

- The LHAPDF interface can be viewed as a successor to PDFLIB.

- Improvements were added.

Using LHAPDF

- The LHAPDF interface must be compiled together with an evolution code

- wrapper to facilitate communication between LHAPDF and the evolution code

- Makefiles compile the evolution and LHPDF code to make libLHAPDF.a

- Evolution codes are interchangeable

  - supplied PDF sets are fit using a particular evolution code
  - preferred evolution code and setting for each PDF set
  - preference is coded in the PDF set input file (extension LHpdf)
  - preferred evolution code can be changed
  - e.g., change the allowed x and/or Q range, the number of grid points

- If a PDF set is selected which has a non-matching evolution code, the current evolution code is used using a default setting

- (editable) default is encoded in the wrapper under entry readevolve

LHAPDF libraries

- two evolution codes: QCDNUM and EVLCTEQ

- QCDNUM with LHAPDFv1
  libLHAPDF-qcdnum.a

- EVLCTEQ with LHAPDFv1
  libLHAPDF-evlcteq.a

- debug versions:
  libLHAPDF-qcdnum_g.a
  libLHAPDF-evlcteq_g.a

Directory Structure

- main directory ($LHAPDF_DIR)
  GNUmakefile
  lhapdf-arch (contains common info for makefiles)

- $LHAPDF_DIR/EVLCTEQ
  Makefile and Fortran code

- $LHAPDF_DIR/QCDNUM
  Makefile and Fortran code

- $LHAPDF_DIR/LHAPDFv1
  Fortran code

- $LHAPDF_DIR/PDFsets
  LH pdf files

- $LHAPDF_DIR/lib
  compiled libraries

- $LHAPDF_DIR/Examples
  the examples

UPS/UPD

- Fermilab Unix Product Support / Distribution

- $LHAPDF_DIR/ups
  lhapdf.table

- To use LHAPDF: setup lhapdf [v1-2]

- To install on your computer: upd install lhapdf v1-2

- ftp access: ftp://ftp.fnal.gov/products/lhapdf/

- upd list -aK+ lhapdf
  "lhapdf" "v1-2" "Linux+2.4" "" "development"

- tar files can easily be downloaded and used without UPS/UPD

Compilation Problems

- code as written uses simple parsing that only works with g77

- don't want to use g77 on non-Linux platforms (e.g., IRIX)

- certainly don't want to impose fixed format

- need a real parser
  - Lynn Garren is working on this
  - "soon"

- does anyone want to run on IRIX, OSF1, or SunOS?

Other Considerations

- libraries are built for all available options

- need interface to PDFLIB

  – Steve Mrenna will write interface to PDFLIB
  – "soon"

- future Pythia release will contain interface

- PDFLIB will be extracted from the CERN libraries and maintained as a separate UPS/UPD product

- Linux development release available since May 2002

- lack of feedback from experiments

Les Houches common block

- add information to StdHep so that LH information can be saved

- April 2002

- stdhep v5_01

- some information required by LH accords already in HEPEVT

- add HEPEV4 with the remaining information

- (also allow for multiple collisions)

- for C++, use HepMC (or CLHEP/StdHep for multiple collisions)

HEPEV4

```
      common/hepev4/eventweightlh, alphaqedlh, alphaqcdlh, scalelh(10),
   1                  spinlh(3,NMXHEP), icolorflowlh(2,NMXHEP), idruplh
C idruplh             : The identity of the current process,
C                        as given by the LPRUP codes.
C eventweightlh       : The event weight:
C                        Equal to (total cross section)/(total generated)
C                        for the output of Pythia, Herwig, etc.
C alphaqedlh          : QED coupling alpha_em.
C alphaqcdlh          : QCD coupling alpha_s.
C scalelh(10)         : Squared Scale Q of the event.
C......Defined for standard 2->1->2 or 2->2 process
C.......kinematics are p1 + p2 -> q1 + q2
C     scalehl(1)= Q2 hard scale (used in PDF and couplings)
C     scalehl(2)= Q2 scale of parton shower
C     scalehl(3)= s-hat, invariant (p1+p2)**2
C     scalehl(4)= t-hat, invariant (p1-q1)**2
C     scalehl(5)= u-hat, invariant (p1-q2)**2
C     scalehl(6)= squared transverse momentum of q1 (i.e., pt-hat**2)
C.......Additionally, for 2->3 processes, p1 + p2 -> q1 + q2 + q3
C     scalehl(7)= squared transverse momentum of q2
C     scalehl(8)= user defined, 0 by default
C     scalehl(9)= user defined, 0 by default
C     scalehl(10)= user defined, 0 by default
C spinlh(3,..)        : spin information
C icolorflowlh(2,..) : (Anti-)Colour flow.
```

StdHep Routines

- only one conversion routine so far

  - pythia2ev4

- two write options

  - stdxwrt(4,istream,lok)
    single collision
    HEPEVT and HEPEV4

  - stdxwrt(5,istream,lok)
    multiple collisions

- need routines (programs?) for CompHEP, MadGraph, ...

  - need documentation for output formats

- clearly need stdhep v5_02

CompHEP

- April 30, 2003

- upd list -aK+ comphep
  "comphep" "v41-10" "IRIX+6.5" "" "development"
  "comphep" "v41-10" "Linux+2.2" "" "development"
  "comphep" "v41-10" "Linux+2.4" "" "development"

for the curious

For those of us who are PowerPoint impaired, this slide show was produced with

- pdfslide.sty
  http://www.ctan.org/tex-archive/macros/latex/contrib/supported/pdfslide/

- texpower.sty
  http://texpower.sourceforge.net/

- *pdflatex myfile.tex*